mined using the RIA assay (performed by Linco Research, St. Charles, Mo.) to be about 5 IU/ mL of liposome suspension.

Blood glucose level at zero hour was taken at 100 percent. Blood glucose levels after the oral administration were normalized by the level at zero hour, and the results were plotted in FIG. **9**. It can be seen that when administered in solution, insulin did not result in any significant change in mouse blood glucose levels (FIG. **9**). This was due to the degradation of the unprotected peptide in the gastrointestinal tract by the digestive enzymes. When insulin was encapsulated in unpolymerized liposomes, no drop in blood glucose level was observed (FIG. **9**), suggesting that the unpolymerized liposomes were not able to protect the encapsulated insulin from degradation. This is consistent with the fact that unpolymerized liposomes are not stable in the gastrointestinal tract, where they are dissolved by the biological detergents. The dissolution results in the exposure of liposomal contents and therefore the loss of liposome protective functions. PBS was also administered to the mice as an experimental control. No significant-decrease was observed in the blood glucose levels (data not shown).

When insulin was encapsulated into the liposomes and the liposomes were subsequently stabilized through polymerization, a significant decrease in blood glucose level (to ~70% of original) was observed at two hours post administration (FIG. **9**). Furthermore, when the polymerized liposomes were surface-modified with URA I molecules, which were shown to target the liposomes to Peyer's patches and give improved oral delivery efficiency, the blood glucose dropped—40% compared to the original level at 3 hours post administration (FIG. **9**). In both cases, no significant change in the glucose level was observed at one hour after the administration. This lag time is due to the gastric and intestinal transit time of these liposomes.

The results of these studies demonstrate the efficacy of lectin modified polymerized liposomes to provide protection for diphtheria toxoid as well as insulin. Both peptides retained their biological activity after the encapsulation and polymerization process. When orally administered to mice, both peptides displayed their desired biological responses. Lectin modified polymerized liposome encapsulated diphtheria toxoid was shown to induce both primary and secondary immune responses in mice and lectin modified polymerized liposome encapsulated insulin was shown to reduce blood glucose levels in mice. These results demonstrate that polymerized liposomes of the invention can be used as delivery systems.

The present invention is not to be limited in scope by the specific embodiments described herein. Indeed, various modifications of the invention in addition to those described herein will become apparent to those skilled in the art from the foregoing description and accompanying figures. Such modifications are intended to fall within the scope of the appended claims.

Various publications are cited herein, the disclosures of which are incorporated by reference in their entireties.

We claim:

1. A polymerized liposome comprising a phospholipid bilayer having phospholipids covalently bonded to each other, an antigen, an adjuvant, and a targeting molecule, wherein the targeting molecule is Ulex Europeans Agglutinin I.

2. A polymerized liposome suitable for oral delivery of an antigen to a mammal, said polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen, and a targeting molecule, wherein the targeting molecule is a lectin which specifically binds to fucosyl sugars.

3. A method of delivering an antigen to a mammal, said method comprising administering to said mammal a polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen, an adjuvant, and a targeting molecule, wherein the targeting molecule is Ulex Europeans Agglutinin I.

4. A method of delivering an antigen to a mammal, said method comprising orally administering to said mammal a polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen, and a targeting molecule, wherein the targeting molecule is a lectin which specifically binds to fucosyl sugars.

5. The method of claim **3**, wherein the liposome is administered orally.

6. The method of claim **3**, wherein the administration of the liposome is sublingal, buccal, intranasal, or rectal.

7. The method of claim **3**, wherein the liposome is administered through the mucosa.

8. A polymerized liposome suitable for oral delivery of an antigen to a mammal, said polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen, and a targeting molecule, wherein the targeting molecule is a lectin which specifically binds to 2'-fucosyllactosamine residues.

9. A polymerized liposome suitable for oral delivery of an antigen to a mammal, said polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen, and a targeting molecule, wherein the targeting molecule is a lectin which specifically binds to M cells with the proviso that the lectin is not WGA.

10. A method of delivering an antigen to a mammal, said method comprising orally administering to said mammal a polymerized liposome comprising a polymerized liposome suitable for oral delivery of an antigen to a mammal, said polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen, and a targeting molecule, wherein the targeting molecule is a lectin which specifically binds to 2'-fucosyllactosamine residues.

11. A method of delivering an antigen to a mammal, said method comprising orally administering to said mammal a polymerized liposome comprising a polymerized liposome suitable for oral delivery of an antigen to a mammal, said polymerized liposome comprising a phospholipid bilayer having phospholipids that are covalently bonded to each other, an antigen and a targeting molecule, wherein the targeting molecule is a lectin which specifically binds to M cells with the proviso that the lectin is not WGA.

12. The polymerized liposome of claim **2**, **8** or **9** further comprising an adjuvant.

13. The method of claim **4**, **10**, or **11** wherein the polymerized lipsome further comprises an adjuvant.

14. The polymerized liposome of claim **1**, **2**, **9** or **10** wherein the antigen is an influenza antigen, an HTLV antigen, a rhinovirus antigen, a herpes virus antigen, or an Epstein-Barr virus antigen.

15. The polymerized liposome of claim **1** in which the antigen is and the adjuvant are in the interior space of the polymerized liposome.

16. The polymerized liposome of claim **12** in which the antigen is and the adjuvant are in the interior space of the polymerized liposome.

17. The polymerized liposome of claim **1** in which the antigen is in the interior space of the polymerized liposome and the adjuvant is in the bilayer of the polymerized liposome.